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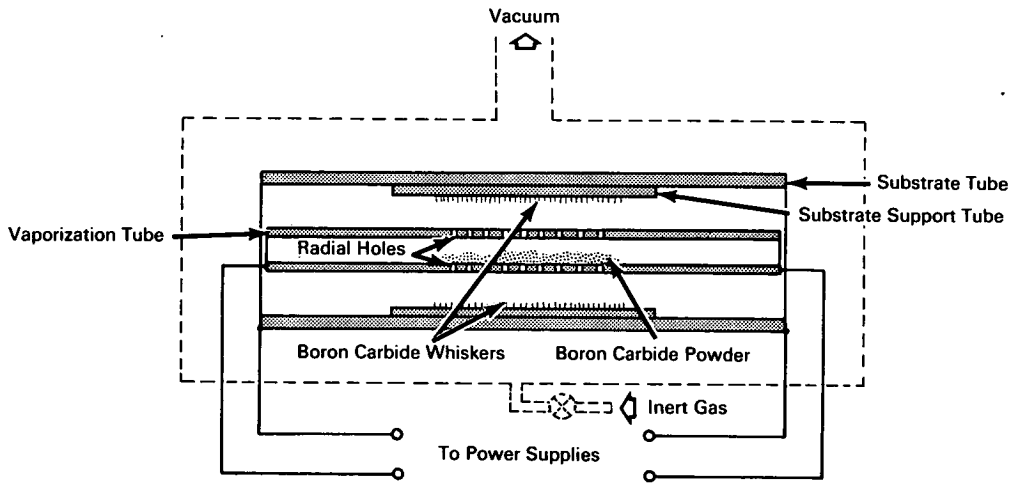
Brief 67-10070

NASA TECH BRIEF

Radial Furnace Shows Promise for Growing Straight Boron Carbide Whiskers



A vapor deposition method of growing boron carbide whiskers is described in Tech Brief 65-10262. Although the chimney-type furnace used in that method produced whiskers of generally high strength and in sufficient yield for tensile testing and characterization studies, the whiskers were short and had both a taper and a curvature.

Further study has shown that by providing a more uniform thermal gradient than can be maintained in the chimney-type furnace, the growth of straight whiskers would be favored. Experiments were therefore conducted with a radial furnace in which the thermal gradients required for whisker growth are normal to the deposition (substrate) surface. The essential features of the furnace are a long graphite vaporization tube with a series of radial holes symmetrically spaced in the central portion of the tube and a concentric graphite tube of larger diameter which supports a graphite substrate tube.

The boron carbide powder contained in the central portion of the vaporization tube is heated to approximately 1900°C, and the resultant vapors diffuse through the radial holes. As the vapors come into contact with the cooler substrate tube they condense and grow into boron carbide whiskers. The proper operating temperatures of the inner and outer tubes are maintained through resistance heating with adjustable power supplies. With this arrangement, the temperature gradient in the annular region between the concentric tubes is radial (i.e., normal) with respect to the surfaces of the tubes. As a consequence, the whiskers tend to grow straight in a direction parallel to the temperature gradient.

Although the whiskers grown in this furnace were straight (not curved like those grown in the chimney furnace) they were only 1 millimeter long and their growth rate was still low. The number of whiskers grown, however, was much greater than in the chim-

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ney furnace, since the available surface area for nucleation and growth of the whiskers was much larger. The concept of the radial furnace appears to offer the greater potential in terms of both quality (high strength) and yield of whisker product.

Note:

Inquiries concerning the radial furnace may be directed to:

Technology Utilization Officer
Headquarters
National Aeronautics and Space Administration
Washington, D.C. 20546
Reference: B67-10070

Patent status:

No patent action is contemplated by NASA.

Source: Earl Feingold
of General Electric Company
under contract to
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(HQ-50)